

Progress Towards a NASA Earth Science Reuse Enablement System (RES)

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About the Reuse Working Group

- Purpose
 - Address technical issues required to enable and facilitate reuse of software assets, including open source products, within the NASA Earth science community.
- Goals
 - To spend less time, money, and effort on software development.
 - To increase productivity and improve quality through reuse.
 - To increase the number of available reusable assets.
- At right are the main types of WG activities.

Reuse Implementation Projects

Efforts that result in the publication or use of a reusable component

Outreach and Education Activities

Efforts that increase community awareness and understanding of benefits, best practices, etc.

Support/Enablement Activities

Efforts that provide tools and mechanisms to enable reuse

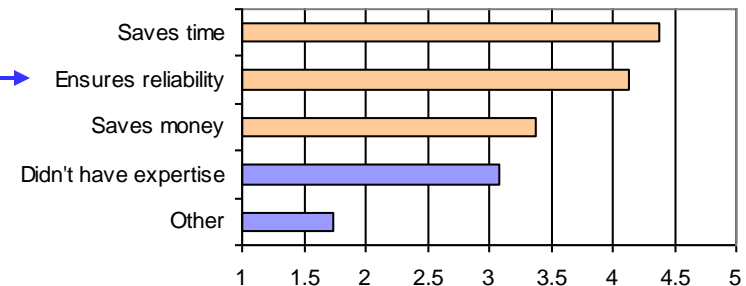
Reuse Incentive Activities

Awards and structural changes that directly or indirectly encourage reuse

Policy Change Activities

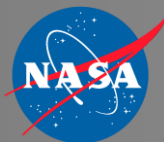
Efforts to reduce policy barriers to reuse

- A survey on the reuse practices of the Earth science community was conducted in 2004 and repeated in 2005 with OMB approval and a wider audience.
- Both surveys show the same basic results:
 - Developers need to be able to easily locate and evaluate available reusable artifacts.
 - **Top three motivations for reuse match the WG goals:**
 - Saving time
 - Ensuring reliability
 - Saving money
 - *Top three factors to increase reuse:*
 - Earth science catalog/repository of reusable assets
 - Greater use of open source licensing
 - More education and guidance on reuse
 - Top two barriers to reuse:
 - Did not know reusable assets existed
 - Did not know where to look for reusable assets



Areas where
the WG is
informing and
improving.

- Based on the 2004 survey results, the WG recommended that an Earth science repository/catalog system be created to meet the needs of the Earth science software developer community.
 - Having a catalog/repository for reusable Earth science assets is one of the best means of increasing reuse in the community.
 - It would also address the top two barriers to reuse.
- Around the same time, the WG developed **use cases and requirements** for the proposed Reuse Enablement System (RES), which were later formalized and revised for clarity.
- In response to the recommendation, NASA Headquarters tasked the WG to perform a trade study to understand the role of existing systems as a potential platform for enabling software reuse.



RES Trade Study

- The WG conducted a **trade study** of various NASA and non-NASA sites, which was completed in 2005.
- The results showed that none of the existing systems satisfied the needs of the community of Earth science software developers.

Requirement/Feature	GCMD	GSFC OSS	Ames OSS
Domain	Earth science	Earth and space science	General science
Type of Assets	Data sets, data services	Open source packages	Open source packages
Register User	☆☆☆	☆☆☆	☆☆☆
Contribute / Update Assets	★★★☆☆	★★★☆☆	★★★☆☆
System Feedback	★★★☆☆	★★★☆☆	★★★☆☆
Automatic Notifications	★★★★☆	★★★☆☆	★★★☆☆
Discovering Assets	Hierarchy, Search	List	List
Register Asset Usage	☆☆☆☆	★★★★☆	★★★★☆
Provide Asset Reviews	☆☆☆☆	★★★☆☆	☆☆☆☆
Monitoring Feedback	★★★☆☆	★★★☆☆	★★★☆☆
Secure Login or Registration	N/A	No	No
Catalog or Repository	Catalog	Both	Both
Operation Support	Large	Small	Small
Technology	RSYNC, Zope, CVS, Linux, Java, and others	PHP	JavaServer pages

A sample of the trade study results is shown here.

RES Architecture Study

- The WG then conducted an **architecture study** to determine what existing software package or system was most suited for reuse in building the RES, which was completed in 2007.
- The results showed that the XOOPS content management system met the most requirements and would take the least time to develop.

Approach Studied	# of Requirements			Effort Estimate [months]
	Met	Not Met	Partially Met	
XOOPS	40	9	5	8.12
Savane	24	20	10	34.10
GCMD	26	24	4	N/A
GForge	20	26	8	N/A

A summary of the architecture study results is shown here.


Note: Efforts for GCMD and GForge were not estimated due to their similarity to Savane in terms of requirements met.

- In accordance with the architecture study results, the WG began work on developing a **prototype RES** built using XOOPS in 2007–2008.
- To meet all of the previously developed RES requirements:
 - Some additions were made, including installing some modules to provide functionality beyond that of the base XOOPS package.
 - Some modifications were made, to the added modules and the base system, as needed.

- As part of its recommendation, the WG estimated the size of the target audience for the RES and the number of assets the RES might contain.
- Target audience
 - NASA's workforce consists of about 82,000 people.
 - About 4% of them are in Earth science, and of these, about 60% are scientists and engineers.
 - Therefore, a lower limit to the audience is about 2,000 people.
- Number of assets
 - As of February 2009, SourceForge contained more than 230,000 projects and over 2,000,000 registered users. [<http://sourceforge.net/about>]
 - Assuming one unique provider per project, about 10% of users are providers, and this estimate is used for the RES.
 - Based on the above audience estimate, if 10% of the users are providers and each offers 1 asset, the RES could contain at least 200 assets.

The software reuse peer-recognition award developed by the WG can provide an incentive for users to contribute assets to the RES.

Views of the Prototype (1 of 3)



NASA Earth Science Data Systems Software Reuse Working Group

Welcome to the Earth Science Data Systems (ESDS) Software Reuse Enablement System.

Software reuse can help the science community by reducing software development timescales, reducing costs, and contributing to the dissemination of knowledge and expertise. This Software Reuse Enablement System (RES) has been established by the Reuse Working Group to bring together a collection of resources that will facilitate reuse within the Earth science community. Over time, we will be collecting a variety of resources in the Earth and space science reuse communities. Our long-term goal is to establish a "marketplace" for reusable software development artifacts, to help establish a knowledge sharing community for software reuse in Earth science. Our [software reuse portal web site](#) has additional information [about our group](#). Please use the menus at the top and left side of the page to navigate to other areas of our site.

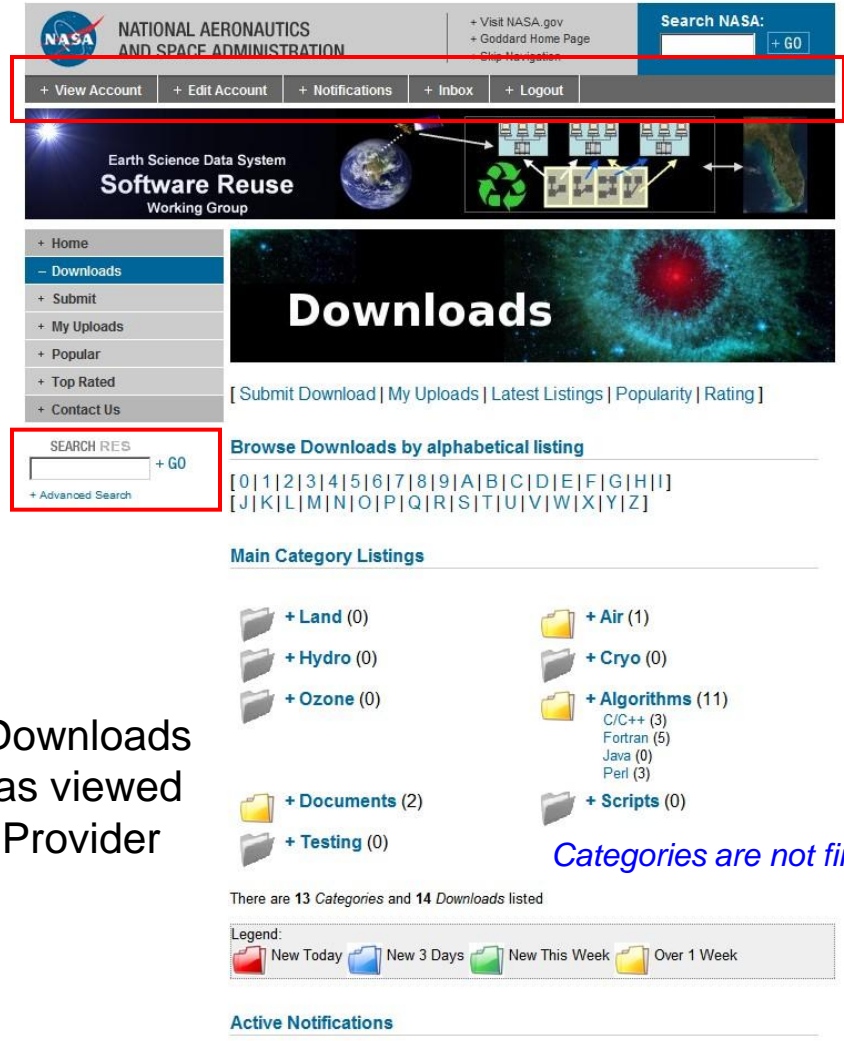
Home page as viewed by an Anonymous User

NASA News

- [+ Expedition 16 Soyuz Lands Safely in Kazakhstan](#)
Astronaut Peggy Whitson returns home from a record flight.
- [+ NASA Deputy Administrator and Florida Governor Discuss Benefits of Space Exploration at Miami Future Forum](#)
NASA Deputy Administrator Shana Dale and Florida Gov. Charlie Crist discussed Friday how space exploration gives Floridians a more competitive economy and better quality of life during a NASA Future Forum at the University of Miami.
- [+ NASA to Broadcast Earth Views in High Definition Television](#)
Since humans first flew in space, nothing has captivated astronauts more than the view of home out the window of their spacecraft.

NASA Image Of The

Consumers would also see this note on the main downloads page (at right):



NASA Earth Science Data Systems Software Reuse Working Group

Downloads

[Submit Download | My Uploads | Latest Listings | Popularity | Rating]

Browse Downloads by alphabetical listing

[0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z]





Main Category Listings

- [+ Land](#) (0)
- [+ Hydro](#) (0)
- [+ Ozone](#) (0)
- [+ Air](#) (1)
- [+ Cryo](#) (0)
- [+ Algorithms](#) (11)
C/C++ (3)
Fortran (5)
Java (0)
Perl (3)
- [+ Documents](#) (2)
- [+ Testing](#) (0)
- [+ Scripts](#) (0)

Categories are not final

There are 13 Categories and 14 Downloads listed

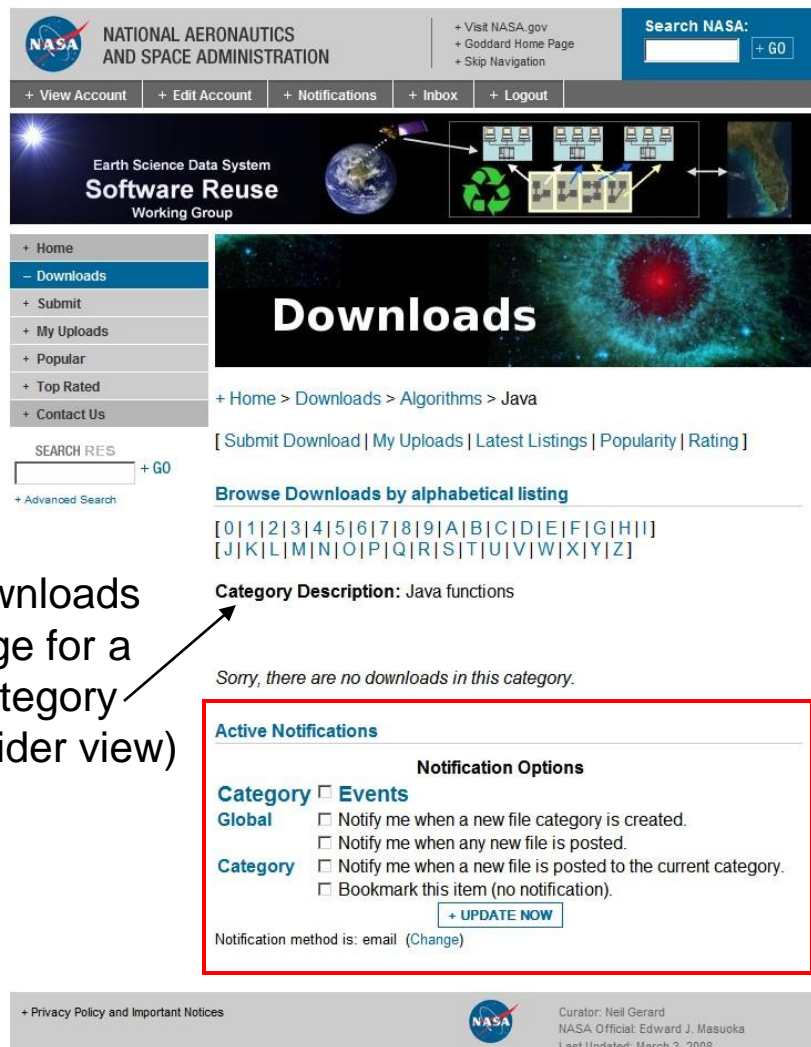
Legend:

 New Today  New 3 Days  New This Week  Over 1 Week

Active Notifications

Note: You currently do not have the ability to upload files. If you would like to do so, find out how to [become a provider!](#)

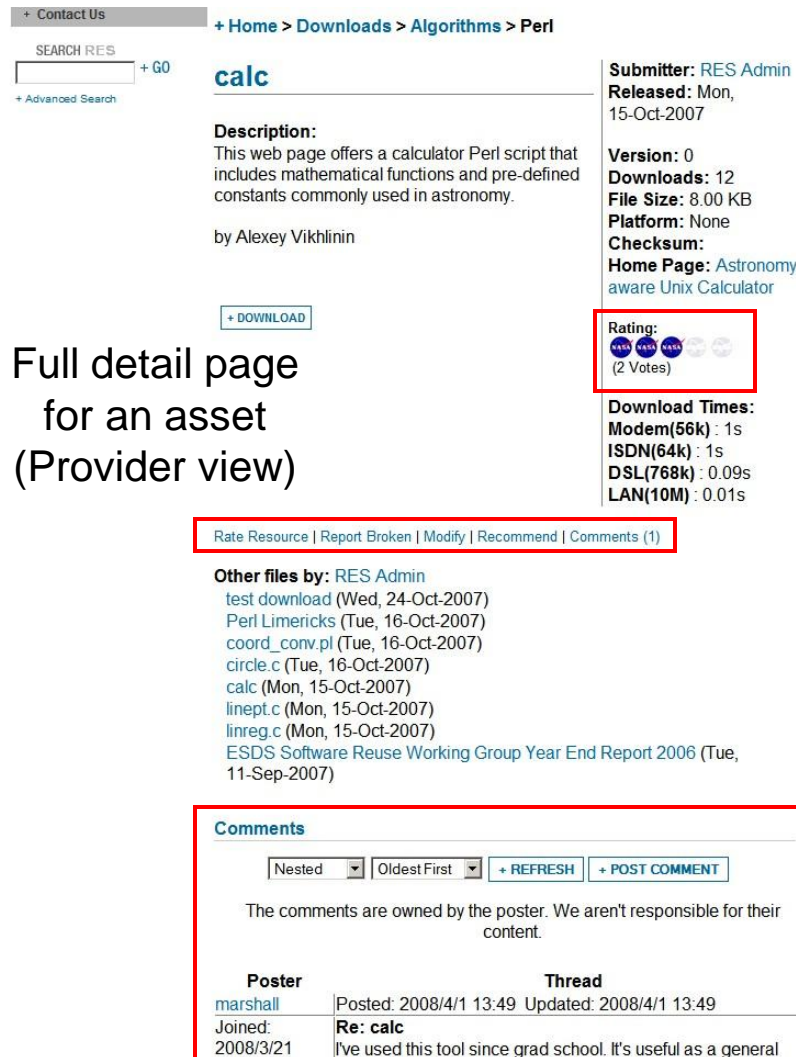
Views of the Prototype (2 of 3)



The screenshot shows the NASA ESDS Software Reuse Working Group website. The top navigation bar includes links for 'View Account', 'Edit Account', 'Notifications', 'Inbox', and 'Logout'. A search bar is also present. The main content area is titled 'Downloads' and shows a list of categories: Home, Downloads, Submit, My Uploads, Popular, Top Rated, and Contact Us. The 'Downloads' category is selected, and the 'Java' sub-category is chosen. The page displays a message: 'Sorry, there are no downloads in this category.' Below this, there are 'Active Notifications' and 'Notification Options' for the 'Global' category. The notification options include checkboxes for 'Notify me when a new file category is created.', 'Notify me when any new file is posted.', 'Notify me when a new file is posted to the current category.', and 'Bookmark this item (no notification)'. A '+ UPDATE NOW' button is also visible. The footer contains a 'Privacy Policy and Important Notices' link, the NASA logo, and information about the Curator (Neil Gerard) and NASA Official (Edward J. Masuoka).

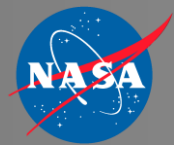
Downloads
page for a
category

(Provider view)



The screenshot shows the full detail page for the 'calc' asset. The top navigation bar includes links for 'Contact Us', 'Home', 'Downloads', 'Algorithms', and 'Perl'. The 'Downloads' category is selected, and the 'Perl' sub-category is chosen. The page displays the 'calc' asset details, including the 'Description', 'Version', 'Downloads', 'File Size', 'Platform', 'Checksum', and 'Home Page'. The 'Description' states: 'This web page offers a calculator Perl script that includes mathematical functions and pre-defined constants commonly used in astronomy.' The 'Version' is 0, 'Downloads' is 12, 'File Size' is 8.00 KB, 'Platform' is None, 'Checksum' is 'Astronomy aware Unix Calculator', and 'Home Page' is 'Astronomy aware Unix Calculator'. The 'Rating' is 0 (2 Votes). The 'Download Times' are: Modem(56k) : 1s, ISDN(64k) : 1s, DSL(768k) : 0.09s, LAN(10M) : 0.01s. The page also includes a 'Rate Resource | Report Broken | Modify | Recommend | Comments (1)' link. Below this, there is a list of 'Other files by: RES Admin' including 'test download', 'Perl Limericks', 'coord_conv.pl', 'circle.c', 'calc', 'linept.c', 'linreg.c', and 'ESDS Software Reuse Working Group Year End Report 2006'. The 'Comments' section shows a single comment by 'marshall' posted on 2008/4/1 13:49, with the text: 'I've used this tool since grad school. It's useful as a general'.

Full detail page
for an asset
(Provider view)



Views of the Prototype (3 of 3)

Administrator menu for Downloads module configuration

The screenshot displays the XOOPS Administrator interface. The top navigation bar includes the XOOPS logo, version information, and links for 'Control Panel Home | XOOPS News' and 'Logout | Home Page'. A left sidebar contains a 'MENU' section with icons for 'SYSTEM ADMIN', 'PD Downloads', 'LIAISE', 'CAPTCHA', and 'PROTECTOR'. The main content area shows the 'Downloads Admin' section with a 'Main Index' button and a 'Module Admin Summary' for the 'PD Downloads' module. The summary includes statistics: Category: 13, Files: 14, Submitted: 0, Modified: 0, Broken: 1. Below this is a 'Server Status' section with information taken from the PHP ini file, listing various settings like GD Library Support, Safe Mode Status, and Max Upload Size. A 'Published Files' table is also visible, listing files with their IDs, titles, posters, submission dates, and publication status.

ID	File Title	Poster	Submission Date	Published	Action
17	Life Cycle Statement	marshall	2008/4/8	●	
15	test download	RES Admin	2007/10/24	●	
13	Perl Limericks	RES Admin	2007/10/16	●	
12	coord_conv.pl	RES Admin	2007/10/16	●	
11	circle.c	RES Admin	2007/10/16	●	
10	Average Inputs	Neil_Provider	2007/10/16	●	

Administrator main menu for basic system configuration

- The WG developed a **test plan** for formal testing of the prototype.
- The WG developed a set of **policies** for the operation and maintenance of the RES.
 - Additional reviews by other relevant offices (e.g., legal, tech. transfer, NASA Headquarters) are planned.
- The WG **documented and packaged** the RES for installation at other sites.
- Some of the Earth science decadal survey missions (e.g., SMAP) are beginning to **implement** instances of the RES.
- This work was performed primarily in 2009–2010.

- The WG's original recommendation to NASA was for the RES to be a single, centralized system.
- Recent direction from NASA has indicated that new missions could benefit from the implementation of a set of distributed systems, run on a per-mission basis.
- Centralized system:
 - One-stop shopping (helps break down barriers to reuse)
 - Domain-specific (focused on Earth science)
 - Operated and maintained by one entity
- Distributed systems:
 - Area-specific (focused on specific sub-domains of Earth science)
 - Generally smaller and thus easier to operate and maintain
 - Allows for some customization based on mission, audience, etc.

Conclusions and Future Work

- The WG conducted surveys of the Earth science software/system development community that indicated a desire for domain-specific catalogs of reusable assets.
- The WG performed a number of studies and development efforts to create a prototype of such a Reuse Enablement System (RES).
- This prototype is starting to be used by the near-term Earth science decadal survey missions.
- The WG is working with the decadal survey missions, including SMAP and ICESat-2, to assist them in creating their own RES instances, and is starting to reach out to other missions, such as DESDynI and OCO-2.
- The WG is also working to standardize the software packaging data model for assets cataloged and stored within each RES, to help with potential cross-system searching or indexing.

Reuse WG Contact Information

- NASA Earth Science Data Systems (ESDS) Working Groups
 - Coordinator, Frank Lindsay
(<http://esdswg.eosdis.nasa.gov/>)
- Software Reuse Working Group
 - Chair: Chris A. Mattmann
(chris.a.mattmann@jpl.nasa.gov)
 - Co-chair: Robert R. Downs
(rdowns@ciesin.columbia.edu)
 - General Info: James J. Marshall
(James.J.Marshall@nasa.gov)
- Social Networks



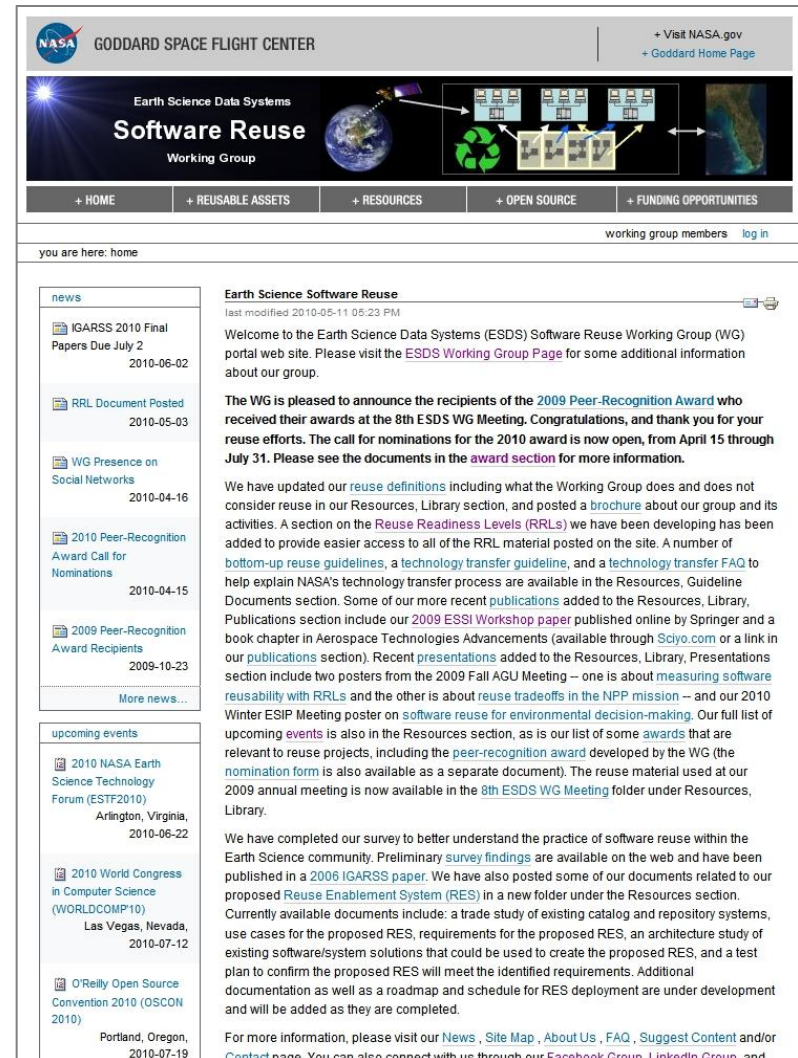
http://twitter.com/esdswg_reuse



<http://www.facebook.com/group.php?gid=117453644936920>



<http://www.linkedin.com/groups?gid=2964349>



The screenshot shows the homepage of the Earth Science Software Reuse Working Group. The header includes the NASA logo and the text "GODDARD SPACE FLIGHT CENTER". Below the header is a navigation bar with links: HOME, REUSABLE ASSETS, RESOURCES, OPEN SOURCE, and FUNDING OPPORTUNITIES. The main content area is titled "Earth Science Software Reuse" and contains a welcome message, a list of recent news items, and a section for upcoming events. The news items include "IGARSS 2010 Final Papers Due July 2", "RRL Document Posted", "WG Presence on Social Networks", "2010 Peer-Recognition Award Call for Nominations", and "2009 Peer-Recognition Award Recipients". The upcoming events section lists "2010 NASA Earth Science Technology Forum (ESTF2010)", "2010 World Congress in Computer Science (WORLDCOMP10)", and "O'Reilly Open Source Convention 2010 (OSCON 2010)".